

Nitrogen and Wheat Grain Production—Topdress N Timing is Critical Sixteen Questions about N for Wheat Grain, Texas High Plains

Calvin Trostle, Professor & Extension Agronomist, Lubbock, (806) 746-6101,
ctrostle@ag.tamu.edu

Jake Mowrer, Assistant Professor & Extension Soil Nutrient & Water Resource Management
 Specialist, College Station, (979) 845-5366, jake.mowrer@ag.tamu.edu

Through regular crop production meetings AgriLife Extension in the Texas High Plains has often observed a common misunderstanding about N fertilizer/N topdress timing and wheat grain production among wheat growers. In the Texas High Plains this is more common as one moves from north to south. Many producers don't realize the critical timing of topdress N on wheat—*and are often not applying topdress N soon enough if they are going to grain*. Thus they are losing yield potential.

Key Definition: “Initial jointing”—This can refer to:

- 1) Development of a plant with an individual stem that now has a node in it (the stem is elongating), or
- 2) Beginning of scattered plants that are starting to joint across a field. This publication emphasizes the latter scenario.

Understanding the importance of the latter definition is a key to properly timing mid-season N applications on wheat to increase yield potential. How do these definitions relate to the wheat stem in Fig. 1, which has already jointed?

In Fig. 1 topdress fertilizer N should have already been applied preferably at least one week ago if this individual plant is typical across the field. If it is the first node of a few scattered plants observed in the field (key definition #2) then topdress N should be applied immediately if it hasn't been already.

Leaf Sheaths Strongly Erect (Feekes Growth Stage 5.0)—Optimum N Topdressing

For a summary relating topdress N requirement and wheat growth stage, consult “Growth Stages of Wheat: Identification and Understanding Improve Crop Management.” SCS-1999-16, from Texas A&M AgriLife Extension (<http://varietytesting.tamu.edu/wheat/docs/mime-5.pdf>). Many varieties of winter wheat have a prostrate growth habit during tillering but now grow vertically at Feekes 5.0 (Figure 2). Historically once the wheat plant becomes strongly erect, all meaningful tiller development has ceased (the exception may be compensatory tiller growth after a damaging freeze). After the appropriate amount of winter chilling, growth resumes, and the growing point differentiates (growing point is located below the soil surface, e.g. crown). *At this stage of growth, the maximum size of the head—the number of seeds per spikelet, and the number of spikelets per head—is being determined.* Optimally timed field applied topdress nitrogen must influence this process for the best economic return. Topdress N application at later dates, though still beneficial, will not affect the potential number of seeds per head (environment will). Delayed N fertilizer after this point can still help yield to a lesser degree, especially if the field was N deficient.

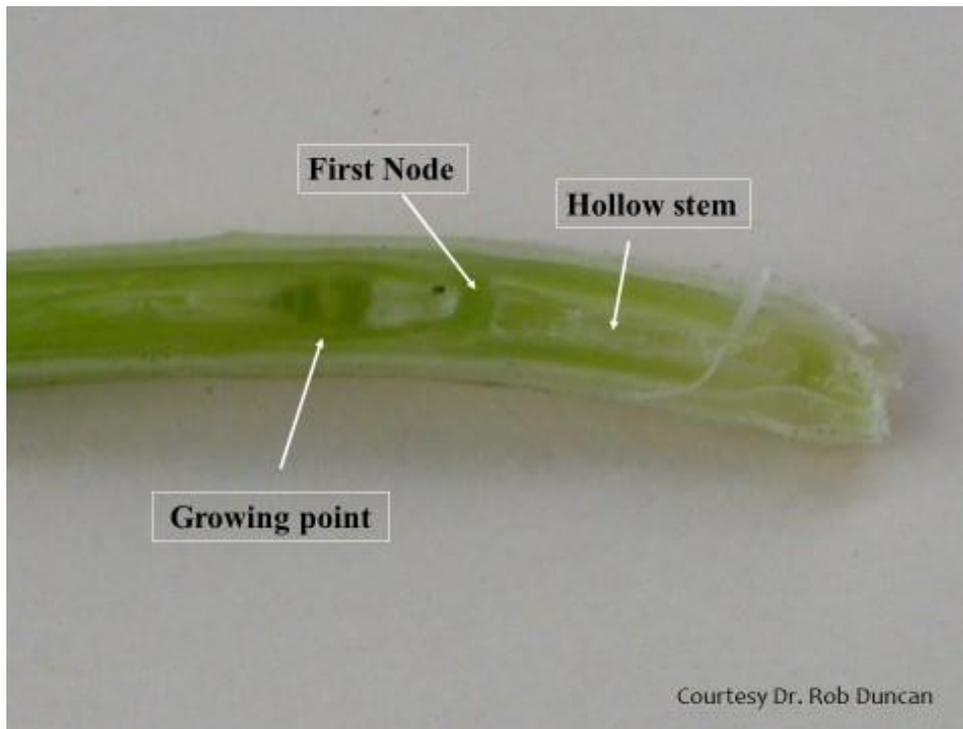


Figure 1. Sliced wheat stem reveals young growing point differentiation with hollow stem to the right. Growing point differentiation—spikelet number and seeds per spikelet—is likely complete. (Photo courtesy Dr. Rob Duncan.)

In summary, tillers that develop after Feekes 5.0 are not expected to contribute to yield. Nitrogen applied at Feekes 5.0 can affect seed per head and seed size, but will not likely affect the number of heads harvested. Thus Feekes 5.0 is the ideal time for “spring” topdressing though actually *late winter* topdressing more accurately describes optimum timing in the Texas High Plains (and elsewhere in Texas). By the time jointing occurs, up to a week or so beforehand, the growing point begins differentiating from producing leaves to now determining the maximum number of potential spikelets and seeds per spikelet in the head.

N Timing Tip: It is sometimes difficult to decide when to topdress. Watch for the earliest nodes in the field. By the time the first few appear, if you have not applied your topdress N, then do so immediately as the rest of the stems across the field likely have growing points that are now differentiating on most tillers.

Many producers miss the jointing stage of growth with their N, and I encourage growers to apply topdress N prior to jointing to ensure the initial topdress N is on the field, in the root zone, and available to plants as the growing point differentiates. (For an explanation of how this N must be in the root zone and what you can do to influence the N getting there, see Question 4.) Initial jointing seems to average about March 1 (± 7 days) in the lower Texas South Plains, then later as you move north into the Panhandle, about March 15-20 in the northwest Panhandle. There isn't all that much difference among varieties though early vs. medium-long maturity will have a small influence as well as late planting dates which will delay jointing some. Moderate to heavy grazing will also delay jointing (but grazing systems should have significant N already applied to drive forage growth).

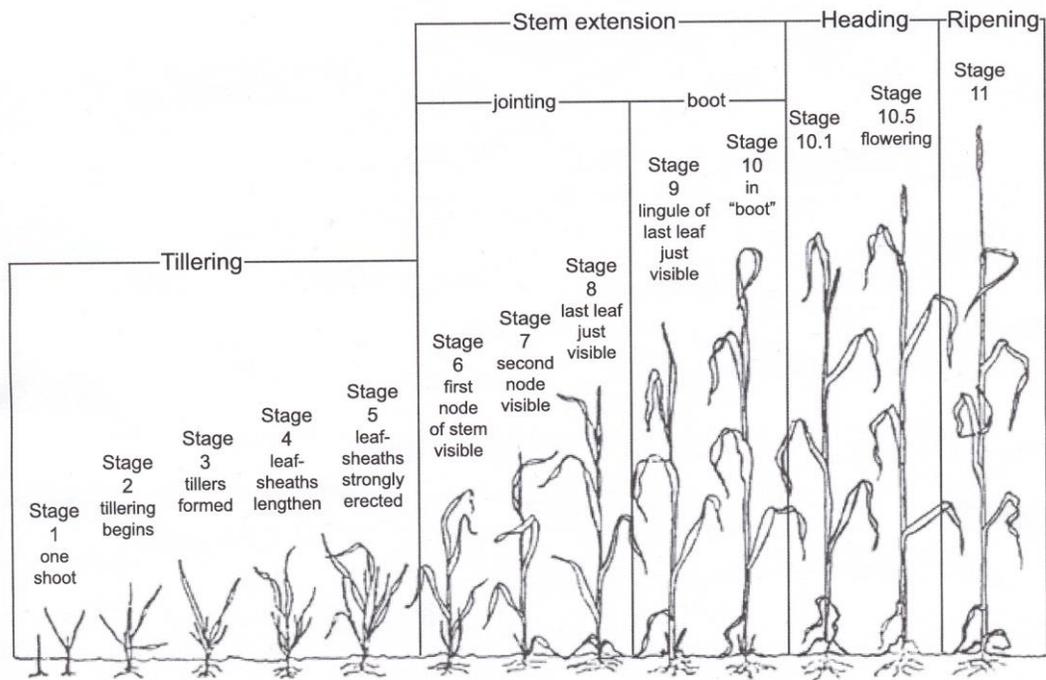
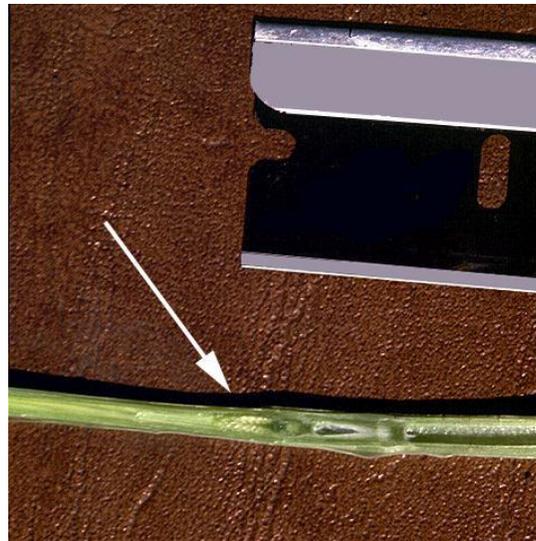


Figure 2. The Feekes scale of growth stages for wheat. Jointing occurs by Stage 6. By the time boot stage (10) occurs most of the N required by the plant has already been taken up.



A



B

Figure 3A-B. A) Leaf sheaths are now strong erect, and jointing is likely underway. B) Growing point differentiation in stem is complete and a small head is developing down in the stem—spikelet number and seeds per spikelet have already been determined. If grazing and then going to grain, then cattle should have been off about 7-10 days prior.

Sixteen Questions about N for Wheat Grain—Texas High Plains

The following questions summarize nitrogen issues for wheat grain production.

- 1) What is the general N requirement for wheat grain production?

About 1.25 lbs. of N per bushel is removed from the field. In contrast the same bushel of wheat grain removes about 0.45-0.50 lbs. of P per bushel. Applied fertilizer N will reflect some inefficiency. Fertilizer N recommendations may vary due to the methods used by an individual laboratory.

- 2) What are the common rules of thumb for gauging the amount of N to apply for wheat grain?

Through the years Texas A&M AgriLife in the Texas High Plains has used two versions of the same rule of thumb for fertilizing nitrogen (N) in wheat for grain depending on available soil test information:

Rule 1A) No soil test: 1.2 lbs. N per bushel of yield goal

Rule 1B) With soil test: 1.5 lbs. N per bushel of yield goal, then adjust fertilizer N down for the level of nitrate-N reported in the soil test (usually a 6" test, but down to 24" if you have deeper soil sample info.) and any other known information like remaining projected N release from previous manure/compost applications or even nitrate-N that might be in the irrigation water.

Rule 2) If grazing then going to grain, fertilize up to 2 lbs. of N per bushel of yield goal at planting, then when the cattle come off (by first jointing), fertilize again with another 0.75 lbs. N per bushel of yield goal. Yes, cattle need to be off by jointing to ensure that grazing doesn't remove heads and reduce grain potential, but earnestly that is probably not soon enough for the additional round of N. Why? Because the growing point has already begun differentiating (potential seed number and spikelet number already being determined). Contact AgriLife Extension for a more refined version of Rule 2 that includes stocker weight, days of grazing, and a constant that may more closely detail N requirements.

Other states may also include factors such as soil type (sandy, clayey), previous crop (a possible N credit if a legume), and soil organic matter, but these factors are not currently included in Texas A&M AgriLife soil test recommendations for any crop.

- 3) When is the best time to top-dress N for grain yield?

The most important stage is to have essentially all nitrogen on the field and in the root zone by the time the growing point differentiates during Feekes growth stage 5 (see page 2). Kansas wheat research as well as other states' research suggests that substantial declines in yield potential may occur if all or even a portion of topdress N is delayed after this stage.

Earlier application may be merited in some instances:

- If you put out minimal N in the fall at planting, or are relying on higher residual soil N to carry the crop to jointing, then at least some N otherwise targeted for initial jointing should be moved forward.
- *In dryland wheat production consider the weather forecast.* Topdress N applications do not become effective until the N is moved into the root zone by rain or melting snow. Therefore, once you are within about one month of when you would normally anticipate N topdressing based on growth stage, watch the weather forecast for a day or two when precipitation chances are significant (especially if well above 50%). Consider fertilizing in advance of the rain or snow chances. If you decide NOT to fertilize and ultimately you do not receive a rain or snow before initial jointing, then you will have missed this initial opportunity to effectively supply timely needed N to the developing wheat crop, and at this point you hope you do not have a prolonged dry spell that extends past jointing.
- **N Timing Tip:** Here is a good rule of thumb for N topdressing on wheat: “If you are having doubts about whether you should go ahead and topdress N on your wheat, go ahead and do it.” The downside of being late is lost yield potential.

- 4) If I make a ground application of N fertilizer vs. applying through a pivot, should I change my application timing?

If broadcast N is applied with a fertilizer spreader when irrigation is available, it is best to time the N application to coincide with the next irrigation to dissolve and wash nitrogen into the root zone. If you need to irrigate but it is a little sooner than you anticipated putting the N on, consider making the N application.

Likewise, when you apply N through pivot irrigation, if you need to irrigate and you are getting close to applying topdress N, then you can go ahead and apply at least some of the needed N (as long as you will irrigate again by the time jointing commences). When applying N through the pivot ensure that your N target is applied by growing point differentiation. (Good moisture conditions are important at this time as well to increase yield potential.) Small amounts of N applied later may align the N use closer to actual plant uptake, but this may not necessarily increase the yield potential by saving some of the N for later than initial jointing. Later N applications have been shown to increase grain protein content, but that is usually ignored when wheat is bought though the issue comes up in some years. Some buyers balk if wheat grain protein is less than 11.5%.

- 5) Is there any benefit for N applied after jointing? What if I am late applying my N, should I still do it?

Late N in some cases may only affect grain protein content, but if a field has a general N deficiency then N applied after jointing (e.g., growing point differentiation largely completed) is still needed to achieve the yield potential (though less) than what was set by the growing point differentiation into the numbers of seeds per spikelet and spikelets per head at that time. So you may “catch up” to the pre-existing yield potential that was set, but you cannot increase it.

- 6) How should N applications for wheat grain production be split between fall and winter?

In general, as a rule of thumb in wheat grain production, apply about 1/3 of the N in the fall (usually pre-plant with likely incorporation) and the remaining 2/3 when the leaf sheaths

become strongly erect, which is before jointing, or no later than when you see initial jointing of a scattered plants across the field. If residual fertility is good then producers may choose to delay initial fall N fertilization until later, but for those producers not applying fall N due to good residual fertility, then it becomes more advisable to move at least some late winter/early spring N application forward with some initial N probably applied in January.

7) Should I split N applications between fall and late winter for dryland wheat?

If you are fertilizing dryland wheat in the fall, which is more likely in the Texas Panhandle, it is acceptable to put all N on in the fall at once. Splitting the N application as noted in #6 above is still agronomically a good idea, but may be impractical for smaller amounts of N. On the other hand, if winter precipitation is good, and the wheat crop looks very good, you may wish to add additional topdress N in the late winter if yield potential appears higher than normal.

Conversely, you may choose to not apply fall N to dryland wheat until you see that you have a satisfactory stand that appears to be worth fertilizing. If you postpone initial N then consider moving topdress N forward (sooner) in the late winter.

8) There is a good chance of rain or snow in the forecast. Should I go ahead and apply my topdress N?

Yes, especially for dryland. In fact, for dryland, I would recommend you place high emphasis on this, even if it might be up to a month before you might normally topdress. Rain or snow dissolves the N fertilizer, which is mobile, and moves it into the root zone. You might not get meaningful precipitation for another six weeks in the High Plains (and after jointing), and furthermore, no applied N is of any value until it is incorporated by moisture, whether naturally or through irrigation.

9) I am debating whether to topdress fertilize now or wait. Should I go ahead?

If you are debating about this, don't discount this possibility. You are generally not hurting yourself to fertilize a couple of weeks before erect growth begins. Note the timing comment in #3 if in doubt.

10) My wheat stand is uniform but thin? Can N management help me overcome a thin stand?

Yes. Fall or winter fertilizer while the crop is still tillering, preferably before you begin to see any significant erect growth should help. So consider advancing some of your N application to drive increased tillering to compensate for the thin stand in the field.

11) Is there a preferred N form to use for wheat topdressing?

Common N forms are all readily soluble, and will dissolve and wash in to the root zone. Choose your N form based on cost per actual unit of N and/or the method or ease of application.

12) Is there a limit on how much liquid N can be applied with a ground rig without burning the leaves?

Texas A&M AgriLife has not documented the burn potential of liquid fertilizer N on the leaves. Reports suggest that 50 units of N is fine, and possibly much more, however, this N must be irrigated into the root zone (and we would not gamble on getting a rain to wash it in). Nitrogen from liquid application may be subject to N losses due to high microbial activity on the leaves, especially if temperatures are warm (into the 70s°F). Ask your fertilizer dealer or applicator for guidance.

- 13) My irrigation water has nitrate-nitrogen (nitrate-N, or NO₃-N) in it—should I apply this toward my N requirement?

Yes. This nitrate-N is fully available to the crop, and it should be credited 100% toward wheat N needs. Most irrigation waters in Texas average about 3 to 10 ppm nitrate-N, and some are much higher, even 20 to 50 ppm nitrate-N. Regions within Texas that tend to have higher irrigation water nitrate-N include the Texas South Plains and several ‘hot spots’ in Texas Rolling Plains aquifers, especially the Seymour Aquifer.

For every 1 ppm nitrate-N in one acre-inch of irrigation, you apply 0.23 lbs. of N per acre. For example, if you have 5 ppm nitrate-N and irrigate 12” then you have applied 14 lbs. N per acre, or about 23% of the N requirement for a 50 bu./A crop.

For further information, see Texas A&M AgriLife’s “Nitrates in Irrigation Water—An Asset for Crop Production, E-619” (DeLaune & Trostle), <http://agriflifebookstore.org>

- 14) Soil sampling below 6” is more common now. Is soil profile N testing at lower depths suitable for wheat?

Yes. This residual nitrate-nitrogen (nitrate-N) to at least 24” deep is fully available to wheat and this sub-soil N should be credited 100% toward crop requirement. Texas A&M AgriLife Extension’s Soil/Water/Forage testing lab in College Station (<http://soiltesting.tamu.edu>) has a specific form for soil profile N testing where producers submit a paired soil sample: A) surface 0-6” is analyzed for most nutrients including N & P, and B) a second sample from 6-12” to as much as 6-24” which is analyzed inexpensively for nitrate-N only. Texas A&M research on numerous different soil types and across the state demonstrates that this nitrate (the most plant available form, not ammonium or other forms) is essentially 100% available, and should be fully credited to crop requirement.

- 15) May I use foliar N products to supply some of my wheat’s N requirement?

Preferably no. Foliar N feeding is reserved only for emergency shortfall in addressing wheat N deficiency and late in season when ground application may not be feasible. It is very expensive to use foliar N products as the per-unit cost of N is much higher than conventional fertilizer products. Wheat will respond quickly (2 to 4 days) to soil-applied N if the N can be moved into the root zone. Use of foliar N and the possible micronutrients they may also contain is generally not economical.

- 16) I had a major freeze that may have hurt my yield potential. Will late N applications drive compensatory tiller growth to recapture yield potential?

Doubtfully. If you have adequately managed your N fertility program for wheat it is doubtful that more N will be required. Nitrogen is mobile within the plant so if the growing point on a stem is killed, then that stem will not grow any more, and N within that stem can be moved

to other stems. Furthermore, when freeze damage occurs, producers are inclined to minimize further inputs as yield potential has likely decreased. I do not recommend changing your N program after a damaging freeze. Added N at this point might in fact drive unwanted vegetative growth that does not contribute significantly to yield.

Other Texas Wheat Regions & Topdress N

- Rolling Plains and Concho Valley. This guide is directly applicable to wheat grain production in these regions.
- South, Central, and Northeast Texas. Information is applicable as well, though timing will move forward on the calendar to match wheat growth stage. In most years, the majority of South and Central Texas should consider topdress timing beginning in late January and into February. When a wet fall delays planting of wheat fields into December and in a few cases even into January jointing likely will not occur until later in February and thus topdress can also be delayed as well. Some nitrogen research in Northeast Texas suggests that applications of topdress N there are more productive and even recommended after jointing.

For updated wheat production information and wheat variety trial results for the Texas High Plains, as well as past summaries, view reports online at:

- <http://varietytesting.tamu.edu/wheat/>
- <http://amarillo.tamu.edu/amarillo-center-programs/agronomy/wheat-publications/>

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